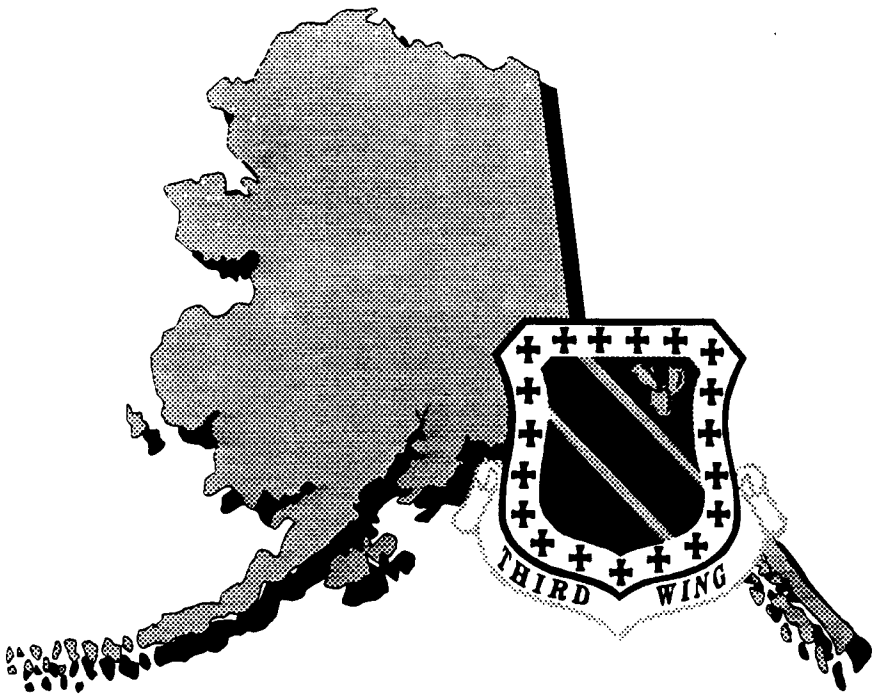



# UNITED STATES AIR FORCE

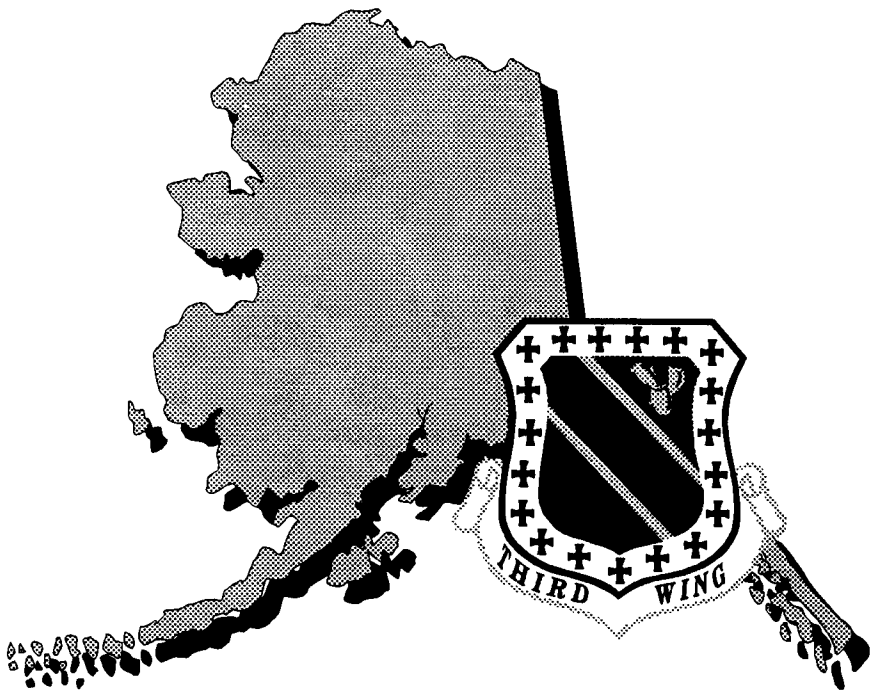
# ELMENDORF AIR FORCE BASE, ALASKA

## ENVIRONMENTAL RESTORATION PROGRAM

# RECORD OF DECISION -- FINAL

# OPERABLE UNIT 1

**SEPTEMBER 1994**




# UNITED STATES AIR FORCE

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# RECORD OF DECISION -- FINAL

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**SEPTEMBER 1994**

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ADEC | Alaska Department of Environmental Conservation |
| AFB | Air Force Base |
| ARARs | Applicable Relevant and Appropriate Requirements |
| BEHP | Bis (2-ethylhexyl) phthalate |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| COC | Contaminant of Concern |
| EDB | 1,2-Dibromoethane |
| EPA | Environmental Protection Agency |
| HI | Hazard Index |
| IRP | Installation Restoration Program |
| MCL | Maximum Contaminant Level |
| NCP | National Contingency Plan |
| NPL | National Priorities List |
| PA/SI | Preliminary Assessment/Site Investigation |
| PCA | 1,1,2,2-tetrachloroethane |
| PCB | Polychlorinated Biphenyl |
| PPM | Part Per Million |
| OU | Operable Unit |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act |
| TPH | Total Petroleum Hydrocarbons |
| TRC | Technical Review Committee |
| UCL | Upper Conficence Limit |

## SECTION 1

## DECLARATION OF THE RECORD OF DECISION

### 1.1 SITE NAME AND LOCATION

Elmendorf Air Force Base (AFB)
Operable Unit (OU) 1
Anchorage, Alaska 99506

### 1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected final remedial action for OU1 at Elmendorf AFB, Alaska, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The decision is based on the administrative record for this site. The Administrative Record Index is at Attachment A. The remedy was selected by the U.S. Air Force and the U.S. Environmental Protection Agency (EPA). The State of Alaska Department of Environmental Conservation (ADEC) concurs with the selected remedy.

### 1.3 ASSESSMENT OF THE SITE

Elevated levels of manganese occurring in the shallow groundwater beneath this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

### 1.4 DESCRIPTION OF THE SELECTED REMEDY

The selected remedy addresses groundwater at OU1, one of seven OUs identified at Elmendorf AFB. The purpose is to reduce the risks associated with exposure to shallow groundwater and thus address the main threat at the site. To accomplish this goal the selected remedy includes institutional controls specifically aimed at restricting use of the shallow aquifer as well as groundwater monitoring to ensure protection of human health and the environment.

The major components of the selected remedy are:

- monitoring groundwater for five years, or until the groundwater no longer poses an unacceptable health risk;
- five-year review to assess the protectiveness of the remedial action;
- periodic evaluation of monitoring results to determine if there is need for further remedial action; and
- maintaining institutional controls restricting access to shallow groundwater.

SPECIFIC INSTITUTIONAL CONTROLS

These controls will remain in effect as long as the Air Force maintains active control of the area or until the groundwater contamination dissipates to such levels that will no longer pose any unacceptable human health or environmental risks. The specific institutional controls to be implemented and/or maintained at OU1 are as follows:

- Development of a site map showing the areas currently and potentially impacted by groundwater contaminants;
- Zoning the affected area for undeveloped outdoor/recreational use only;
- Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU1 at Elmendorf AFB; and
- Securing of existing water supply and groundwater monitoring wells.

## 1.5 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment to the maximum extent practicable. However, treatment of the groundwater was found to be impractical because of the potential to release other harmful constituents in the process; therefore, the remedy does not satisfy the statutory preference for treatment as a principal element.

Because the remedy will result in the continued presence of hazardous substances on the site above health-based levels, a review will be conducted within five years of commencement of the remedial action, to ensure that the remedy continues to provide adequate protection of human health and the environment.

**LEAD AND SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION, ELMENDORF AIR FORCE BASE, ALASKA OPERABLE UNIT 1**

Signature sheet for the foregoing Record of Decision for the Operable Unit 1 final action at Elmendorf Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the State of Alaska Department of Environmental Conservation.

THOMAS W.L. McCALL, Jr.
Deputy Assistant Secretary of the Air Force
(Environment, Safety, and Occupational Health)

9.27.94
Date

## LEAD AND SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION, ELMENDORF AIR FORCE BASE, ALASKA OPERABLE UNIT 1

Signature sheet for the foregoing Record of Decision for the Operable Unit 1 final action at Elmendorf Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the State of Alaska Department of Environmental Conservation.

Chuck Clarke — 9/29/94

CHUCK CLARKE
Regional Administrator
Region X
U.S. Environmental Protection Agency

Date

**LEAD AND SUPPORT AGENCY ACCEPTANCE OF THE RECORD OF DECISION, ELMENDORF AIR FORCE BASE, ALASKA OPERABLE UNIT 1**

Signature sheet for the foregoing Record of Decision for the Operable Unit 1 final action at Elmendorf Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the State of Alaska Department of Environmental Conservation.

Janice Adair — 9/29/94

JANICE ADAIR — Date
Regional Administrator
Southcentral Regional Office
Alaska Department of Environmental Conservation

## SECTION 2

## DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the conditions at OU1, the remedial alternatives, and the analysis of those options. Following that, it explains the rationale for the remedy selection and describes how the selected remedy satisfies statutory requirements.

### 2.1 SITE NAME, LOCATION, AND DESCRIPTION

Elmendorf AFB is located on 13,035 acres bordered on the south by the city of Anchorage, on the east by the U.S. Army's Fort Richardson, and on the north and west by the Knik Arm of Cook Inlet (Figure 1). Base operations since the mid-1940s have generated varying quantities of hazardous and non-hazardous wastes. The major sources of hazardous wastes include industrial operations (shops), fire training and fuels management.

There are 29 source areas being addressed under CERCLA at Elmendorf AFB. These were divided into 7 operable units for investigation. The ROD for OU1 is the first of six planned for documenting final action.

OU1 consists of five general waste disposal areas (LF05, LF07, LF13, LF59, and OT56) located next to the Davis Highway (Figure 2). Each of these source areas is described below. The area is zoned undeveloped outdoor recreational use and consists of grassy fields, gravel pits and wooded areas adjacent to Ship Creek.

LF05 - This 17-acre landfill was operated from 1951 to 1973. General refuse, scrap metal, used chemicals and other scrap materials were disposed in this landfill.

LF07 - This 35-acre landfill was operated from 1965 to 1982 for the disposal of base-generated refuse, scrap metal, construction rubble, drums of asphalt, empty pesticide containers and small amounts of shop wastes. A portion of the landfill also received wastes containing asbestos until 1992.

LF13 - This 2-acre, former gravel pit was used as a disposal area for empty drums, metal piping, drums of asphalt and small quantities of quicklime from 1967 to 1971.

LF59 - This area consists of two one-half acre landfills and a tar seep in the southwestern portion of OU1. The landfills received general refuse and construction debris from 1965 until 1983. The tar seep is located in a wooded area next to the base jogging trail and is a remnant of a former asphalt batch plant located near Second Avenue and Davis Highway.

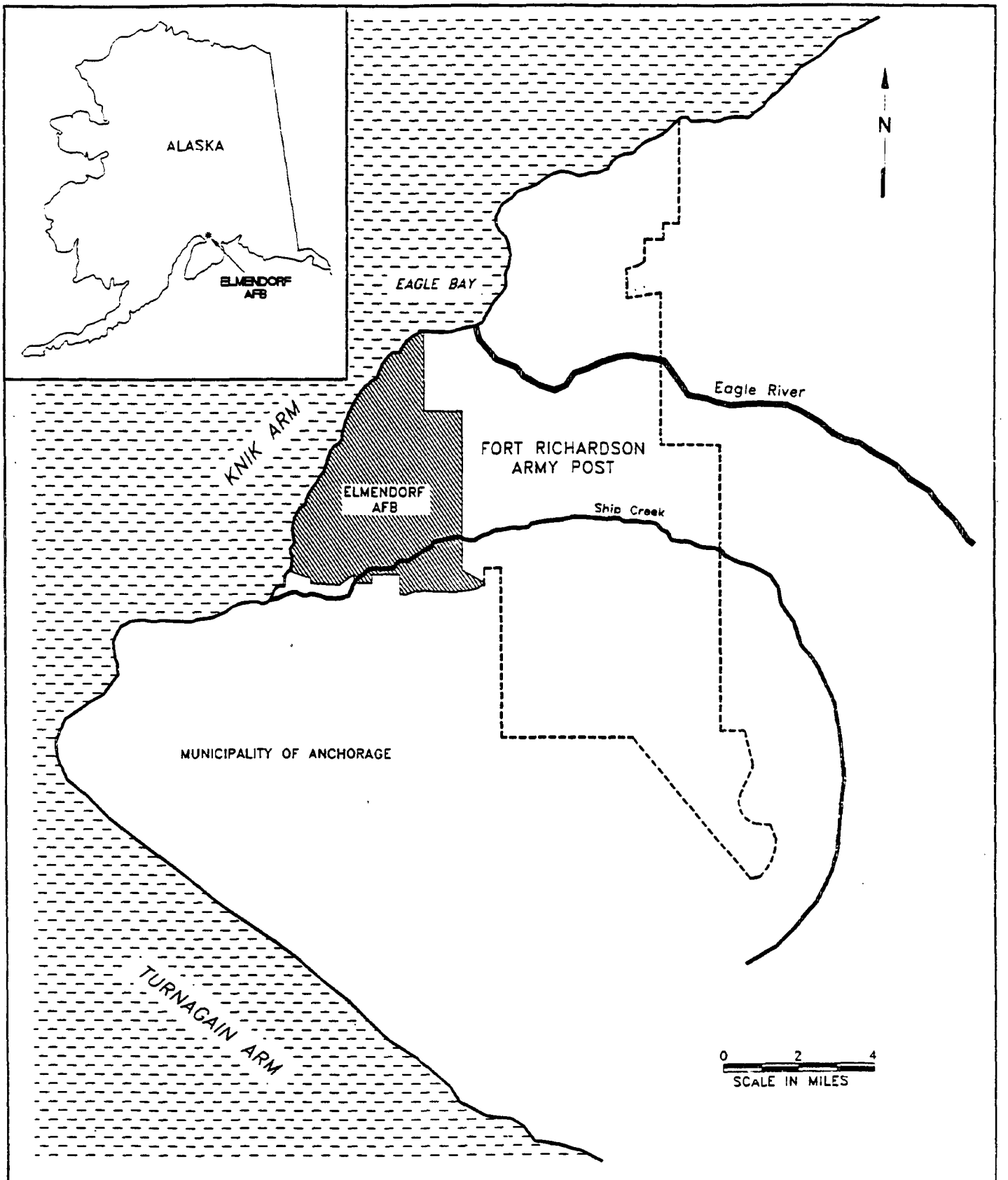


FIGURE 1
LOCATION MAP
Elmendorf Air Force Base, Alaska



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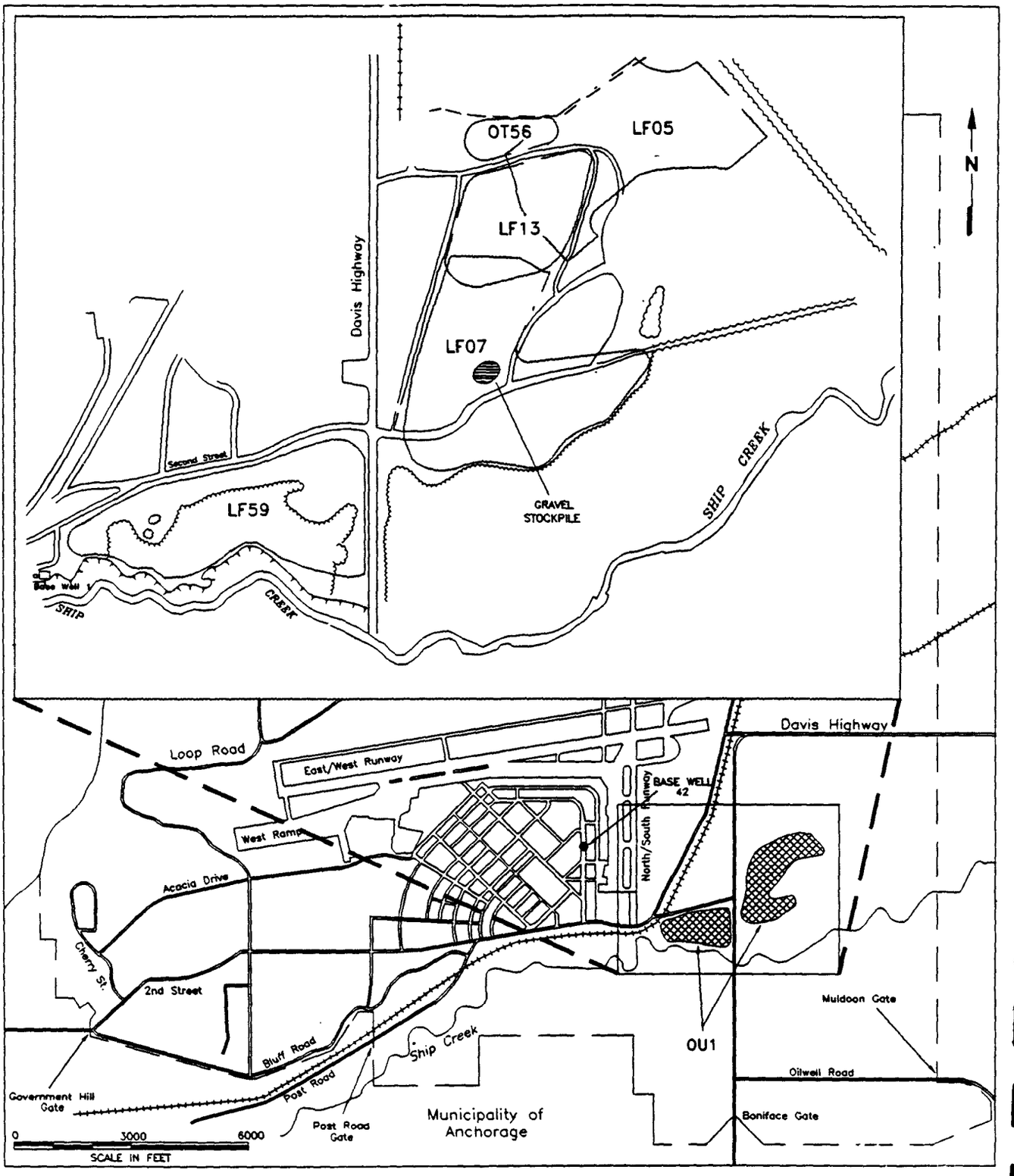



FIGURE 2
Location Map of CERCLA
Operable Unit 1
Elmendorf Air Force Base, Alaska

OT56 - This Defense Reutilization and Marketing Office area occupies approximately 2.5 acres. Various materials, such as scrap metal and drums, were stored in the area for an unknown period of time. OT56 is no longer in use.

Ship Creek, located directly south of OU1, forms the major topographic feature at the site. OU1 is part of the lower Ship Creek drainage area. The stream valley of Ship Creek crosses through the Elmendorf property for 4.2 miles between Fort Richardson and Post Road. Ship Creek has the only 100-year floodplain designated on the installation. Wetlands occupy a portion of the Ship Creek valley, occupying abandoned stream channels and oxbows. Most are only seasonally flooded during high flow periods, and are not considered to be prime wildlife habitat. The most commonly seen species observed in these areas is the wood frog. Surface-water from Ship Creek has been used extensively at Elmendorf AFB for a number of years. Much of the surface water collected is used for industrial, fire fighting, hospital, and domestic utility uses.

Elevations across OU1 range from a high point of approximately 215 feet above mean sea level in the northeast to a low point of approximately 175 feet above mean sea level in the southwest. The surface is underlain by unconsolidated, permeable sands and gravel of the glacial outwash plain. The sediments are flat lying to gently sloping in a southern to southwestern direction toward Ship Creek. The horizontal gradient is approximately 110 feet per vertical mile.

Two major sources of groundwater have been identified in the Anchorage area: a shallow, unconfined aquifer system , and a deeper, confined (artesian) aquifer. The Bootlegger Cove formation forms the lower limit of the shallow aquifer and is the confining layer of the deeper artesian aquifer.

OU1 is located approximately three-quarters of a mile northeast of the nearest populated subdivision of the City of Anchorage and is separated from the populated area by Ship Creek.

## 2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Contaminant source areas LF05, LF07, and LF13 were first investigated through a records search as part of the Preliminary Assessment/Site Investigation (PA/SI) conducted by the Air Force in 1983. Characterization of contaminant distribution within the landfill area was initially investigated in 1986 during the SI studies. As part of the site investigation, four groundwater monitoring wells were installed and sampled. During construction of the monitoring wells, four subsurface soil samples were collected. During 1988, additional field investigations were conducted at LF05 and LF07, including completing a geophysical

survey, installing six additional monitoring wells, sampling Ship Creek near OU1, and sampling groundwater from all existing groundwater monitoring wells, including Base Well 1. Base Well 1 is a shallow well located in the Ship Creek alluvium near the southwestern corner of OU1 and formerly served as a potable water supply for the base. Contamination was detected in groundwater samples collected in 1988. The geophysical survey indicated that buried wastes were present in both areas. Findings and conclusions of the individual investigations are available in the final reports for each. These reports and other pertinent documents are part of the administrative record for the site.

In 1990, the State of Alaska, Department of Transportation and Public Facilities determined the presence of volatile organic contamination in a gravel stockpile located within source area LF07. Gravel from this stockpile was used as road base in the construction of a portion of Boniface Parkway. Because contaminants were known to exist in groundwater at OU1, the gravel was also sampled. Ten soil samples collected from the stockpile revealed volatile organic contamination.

Source areas LF05 and LF07 were investigated again in 1990 using gamma logging of boreholes, subsurface soil sampling of boreholes, reviewing aerial photographs, performing terrain conductivity and ground-penetrating radar surveys, and installing six additional monitoring wells. Water-level measurements were made at 13 wells within OU1 to assess the local groundwater flow directions. Groundwater samples were also collected from all groundwater monitoring wells at OU1. Base Well 1 was sampled for comprehensive chemical analyses. In addition, slug tests were conducted in seven wells within OU1.

Elmendorf AFB was proposed for the National Priorities List (NPL) in 1989 and placed on the NPL in August of 1990. In November 1991, a Federal Facilities Agreement negotiated between the Agencies established a cleanup schedule for the base.

In accordance with the new cleanup schedule, additional field investigations were performed at OU1 in 1992 to supplement earlier studies and to provide additional subsurface soil, surface soil, sediment, surface water, and groundwater data. These data were needed to complete a RI, baseline risk assessment, and feasibility study. At the conclusion of this RI a total of 32 groundwater monitoring wells, 20 methane monitoring wells, and 27 soil borings had been installed.

## 2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

In 1992, Elmendorf AFB assembled a Technical Review Committee (TRC) composed of representatives from local community councils, federal and state regulatory agencies, and a community at large member. Quarterly meetings provide Elmendorf AFB an opportunity to brief the TRC on installation environmental restoration projects and to solicit input from the TRC. Three TRC meetings were held during preparation of the investigation and feasibility study reports for OU1. In those meetings, the TRC was informed as to the scope and methodology of the OU1 investigation and proposed plans for remediation.

The Proposed Plan for OU1 was released to the public on April 4, 1994. This began a 30 day public comment period which ended on May 3, 1994. Documents detailing the findings of the investigation and evaluation of alternatives were made available to the public at information repositories located at the following locations: Consortium Library, University of Alaska, Anchorage, Alaska; and Alaska Resources Library, Bureau of Land Management, Federal Building, Anchorage, Alaska. Notice of the availability of the proposed plan and of an upcoming public meeting were published in the Sourdough Sentinel on April 1, 1994 and in the Anchorage Daily News on April 3, 1994. The public meeting was held April 21, 1994 at the Federal Building, Anchorage, Alaska. The purpose of the meeting was to inform the public of the preferred alternative, the alternatives evaluated, answer questions and seek public comment. Representatives from Elmendorf AFB, EPA, and ADEC were present at the meeting to answer questions about OU1 and the alternatives considered. Transcripts of the meeting and written comments received during the comment period are included in the Administrative Record file for the site. A responsiveness summary can be found at Section 3 of this ROD.

## 2.4 SCOPE AND ROLE OF OPERABLE UNIT

The Federal Facility Agreement organized the CERCLA study sites at Elmendorf AFB into seven OUs, on the basis of geographic proximity and similar source characteristics or contaminants. OU1, the subject of this ROD, addresses problems resulting from the release of hazardous substances from five waste disposal areas described in Section 2.1; however, potential environmental concerns outside of CERCLA are being addressed under separate base cleanup programs as discussed below.

The OU1 investigation determined that the solid wastes do not warrant further action pursuant to CERCLA. Certain solid wastes, including the tar seep at LF59 and scrap metal that is scattered throughout the area, are being investigated under separate base cleanup programs under jurisdiction of Alaska's solid waste

regulations. In addition, a permitted sanitary landfill formerly operated upgradient of the OU1 landfills is being closed pursuant to the States' solid waste program.

Furthermore, OU6 will investigate environmental risks to Ship Creek (within the boundaries of Elmendorf AFB) to determine the full environmental impact from all nearby operable units, including OU1. The ROD for OU6, due in August 1996, will finalize CERCLA activities at Elmendorf AFB.

## 2.5 SITE CHARACTERISTICS

OU1 has been the subject of several investigations conducted between 1981 and 1993. The data from studies prior to 1991 were not validated, so those data were reviewed and analyzed and used to select locations for the subsequent field work, the analytical results of which are compiled in the RI/FS for OU1. The RI leading to this ROD was conducted in three phases during fall 1991, spring 1992, and fall 1992. Soil borings drilled in and around OU1 have been used to determine the presence and extent of soil contamination and to investigate the geology of the site. A network of 32 groundwater monitoring wells was used to identify and map groundwater contamination and to determine aquifer characteristics.

### 2.5.1 Geology and Hydrogeology

The geology of OU1 was investigated by logging borings drilled in soil, by surface geology investigations, and by interpretation of geophysical survey results.

Two major sources of groundwater have been identified in the Anchorage area: a shallow, unconfined aquifer system and a deeper, confined (artesian) aquifer. The Bootlegger Cove formation forms the lower limit of the shallow aquifer and is the confining layer of the deeper artesian aquifer.

The shallow aquifer consists of alluvial deposits from Ship Creek and glaciofluvial gravel deposits which are typical in the outwash plain south of the Elmendorf moraine, the dominant topographic feature on Elmendorf AFB.

Surficial alluvial deposits at OU1 are comprised of channel gravels and sands deposited in and on either side of Ship Creek. These deposits are approximately one-third of a mile wide where Ship Creek transects OU1. These deposits are generally well bedded and well sorted.

Outwash plain gravels were deposited from braided glacial meltwater streams issuing from the ice margin. Outwash plain

deposits at OU1 consist of a relatively homogeneous sequence of massive to crudely bedded, poorly sorted sandy gravels and include relatively thin lenses of sand. Thick sections of these deposits can be seen in the walls of the landfills at OU1. Channeling is common, and the gravel forms pods, lenticular bodies, and channel fills. Fluvial features such as point bar sands and channel lag gravels can also be observed. These deposits directly overlie the Bootlegger Cove formation and, based on drillhole intercepts, average 108 feet thick in the central landfill area and 75 feet thick in the vicinity of LF59.

The Bootlegger Cove formation is a fine-grained glacioestuarine deposit composed of silt, clay and sand with fines. The surface topography of the formation is hummocky with incised channels, formed from glacial outwash streams. The thickness of the formation is not well defined due to its variability and gradational contacts. Gradational zones above and below the Bootlegger Cove, approximately 20 to 25 feet thick, are characterized by interfingered clays, silty sand, and gravel. Underlying the Bootlegger Cove are older glacial deposits. These deposits compose the principal aquifer underlying Anchorage.

Because of both topographic and lithologic variability, the depth to saturation within the individual shallow aquifer units varies from ground surface to more than 50 feet. Water-level depths in wells at OU1 range from 5.38 feet below ground surface near Ship Creek to 40.57 feet below ground surface near the southeast corner of OU1.

A review of historical water levels and water levels collected during the RI field work shows shallow aquifer groundwater flow direction. Along the eastern boundary of OU1, flow is toward the west-northwest; near the western extent of OU1, it has a west-southwest component. The average hydraulic gradient within the unconfined aquifer ranges between 0.004-0.007 ft/ft.

### 2.5.2 Nature and Extent of Contamination

The environmental media sampled during the 1991-1992 RI were soil, sediment, surface water, and groundwater. The results of the investigation are summarized below. Discussion has been limited to contaminants that were determined to be of concern as described in the summary of site risk, Section 2.6.

The extent of contamination in surface and subsurface soils was assessed by collecting soil samples for chemical analyses. The sampling is discussed in detail in the RI/FS Report. Table 1 presents information on the frequency of detections and concentrations of compounds found in the soil and other media at OU1.

# TABLE 1
# POTENTIAL CONTAMINANTS OF CONCERN

| CONTAMINANT | MAXIMUM DETECTION | | FREQUENCY | MAXIMUM RISK/HI[1] |
|---|---|---|---|---|
| | CONC | | | |
| GROUNDWATER | (ug/l) | Well/Date | | |
| Benzene | 2.5 | LF05-MW07/F92 | 5/54 | 2.5E-06 |
| BEHP[2] | 68.0 | LF05-MW13/F92 | 12/52 | 1.0E-05 |
| 1,2-Dibromoethane[3] | 0.38 | LF05-W5/F92 | 7/43 | 3.8E-04 |
| Cis 1,2-Dichloroethene | 6.7 | LF05-2C/F92 | 8/53 | <1.0E-06 |
| Methylethylketone | 290.0 | LF05-MW11/F92 | 3/52 | <1.0E-06 |
| Polychlorinated Biphenyl[4] | 14.0 | LF05D1302/F91 | 1/38 | 3.4E-03 |
| 1,1,2,2-PCA[6] | 11.0 | LF59-MW02/F92 | 3/51 | 6.8E-05 |
| Tetrachloroethylene | 3.7 | LFO5GW2B/S92 | 4/53 | 1.6E-06 |
| Toluene | 110.0 | LF05-MW11/F92 | 6/52 | <1.0E-06 |
| Trichloroethylene | 8.2 | LF05GW2B/F91 | 7/53 | 2.1E-06 |
| Vinyl Chloride | 3.3 | LF05-MW10/F92 | 1/52 | 8.4E-05 |
| Arsenic[6] | 140.0 | LF05-W6/F92 | 33/47 | 2.9E-03 |
| Barium | 610.0 | LF05-MW10/F92 | 32/53 | <1.0E-06 |
| Beryllium[7] | 3.0 | LF05GW2B/F91 | 1/53 | 1.6E-04 |
| Fluoride[8] | 5200.0 | LF05GW2B/F91 | 5/53 | 2.4 HI |
| Lead[9] | 130.0 | LF05-W5/F91 | 35/53 | 63% |
| Manganese | 33300.0 | LF05-MW04/F92 | 52/53 | 198.0 HI |
| Nickel | 310.0 | LF05-MW10/F92 | 23/53 | <1.0 HI |
| SURFACE WATER | (ug/l) | | | |
| TPH[10] | 1600.0 | | 1/3 | NA |
| SEDIMENT | (mg/kg) | | | |
| TPH[10] | 120.0 | | 4/4 | NA |
| LEAD[11] | 21.7 | | 4/4 | NA |
| SURFACE SOIL | (mg/kg) | | | |
| Benzo (a) anthacene | 0.58 | | 1/15 | 3.8E-06 |
| Benzo (k) fluoranthene | 0.43 | | 1/15 | 2.9E-06 |
| BEHP | 13.0 | | 1/15 | <1.0E-04 |
| 2-Methynaphthalene[12] | 1.2 | | 4/15 | NA |
| Antimony | 14.6 | | 1/15 | <1.0 HI |
| Arsenic | 8.0 | | 11/15 | <1.0E-04 |
| Barium | 2110.0 | | 5/15 | <1.0 HI |
| Cadmium | 20.6 | | 2/15 | <1.0 HI |
| Copper | 135.0 | | 15/15 | <1.0 HI |
| Lead[13] | 346.0 | | 15/15 | NA |
| Mercury[14] | 0.3 | | 5/15 | NA |
| Zinc | 379.0 | | 15/15 | <1.0 HI |

# TABLE 1 (Continued)
# POTENTIAL CONTAMINANTS OF CONCERN

| CONTAMINANT | MAXIMUM DETECTION | | FREQUENCY | MAXIMUM RISK |
|---|---|---|---|---|
| SUBSURFACE SOIL | CONC (mg/kg) | | | |
| Benzo (b) fluoranthene | 0.25 | | 1/107 | N/A |
| Chrysene | 0.5 | | 1/107 | N/A |
| PCB (Aroclor 1260) | 0.42 | | 1/90 | N/A |
| TPH[15] | 35000.0 | | 86/92 | N/A |
| Arsenic[16] | 30.9 | | 84/102 | N/A |
| Beryllium | 0.7 | | 2/102 | N/A |
| Sodium | 1180.0 | | 100/102 | N/A |

1 Risk from drinking groundwater from an unfiltered shallow well in the immediate vicinity of the highest concentration of COC over a time of 30 years.

2 BEHP = Bis-(2-ethylhexyl) phthalate

3 1,2-Dibromoethane (EDB) was only detected once with a concentration above EPA acceptable risk ranges.

4 Polychlorinated Biphenyl (PCB) was only detected once in one well, subsequent sampling events failed to confirm it's presence. Data is of questionable validity.

5 1,1,2,2-PCA = 1,1,2,2-tetrachloroethane.

6 Only four samples detected slightly above background risk. Risk does not appear to be site related.

7 Only detected once and risk did not exceed the sample quantification limit risk.

8 Only one detection above the HI of 1.0

9 When greater than 5% of potentially exposed children are estimated to have blood levels exceeding 10 ug/l, a hazard due to lead is deemed to exist. Only one well location is associated with total lead concentrations across all three rounds of sampling greater than 5%.

10 TPH = total petroleum hydrocarbons. Data is not usable for risk assessment.

11 Not significantly different than background and exposure very highly unlikely.

12 No toxicity established and not a suspected carcinogen.

13 All were within background range except for only one sample.

14 Toxicity values not available. Three samples close to background range with others under.

15 All detects are TPH. Only seven samples were above state clean-up levels for non-UST contaminated soil.

16 Only five samples exceeded EPA acceptable risk ranges.

The presence of contamination in surface water was assessed by compiling and reviewing data collected by the Elmendorf AFB Bioenvironmental Services. In addition, surface water samples were collected and analyzed from seeps and surface water bodies at LF59. The procedures used and results of surface water sampling are discussed in the RI/FS Report for OU1.

The extent of contamination in groundwater was assessed by collecting samples for chemical analyses from 31 new and existing wells. Water samples were collected in fall 1991, spring 1992, and fall 1992. The majority of the monitoring wells are screened in the shallow, unconfined aquifer, with the exception of 2 deep wells installed to monitor the confined aquifer underneath the Bootlegger Cove formation. Well construction and groundwater sampling are discussed in detail in the RI/FS Report.

Five compounds were detected in groundwater at concentrations that were later determined to be a potential risk as described in Section 2.6: arsenic, 1,2-dibromoethane (EDB), polychlorinated biphenyl (PCB), lead, and manganese.

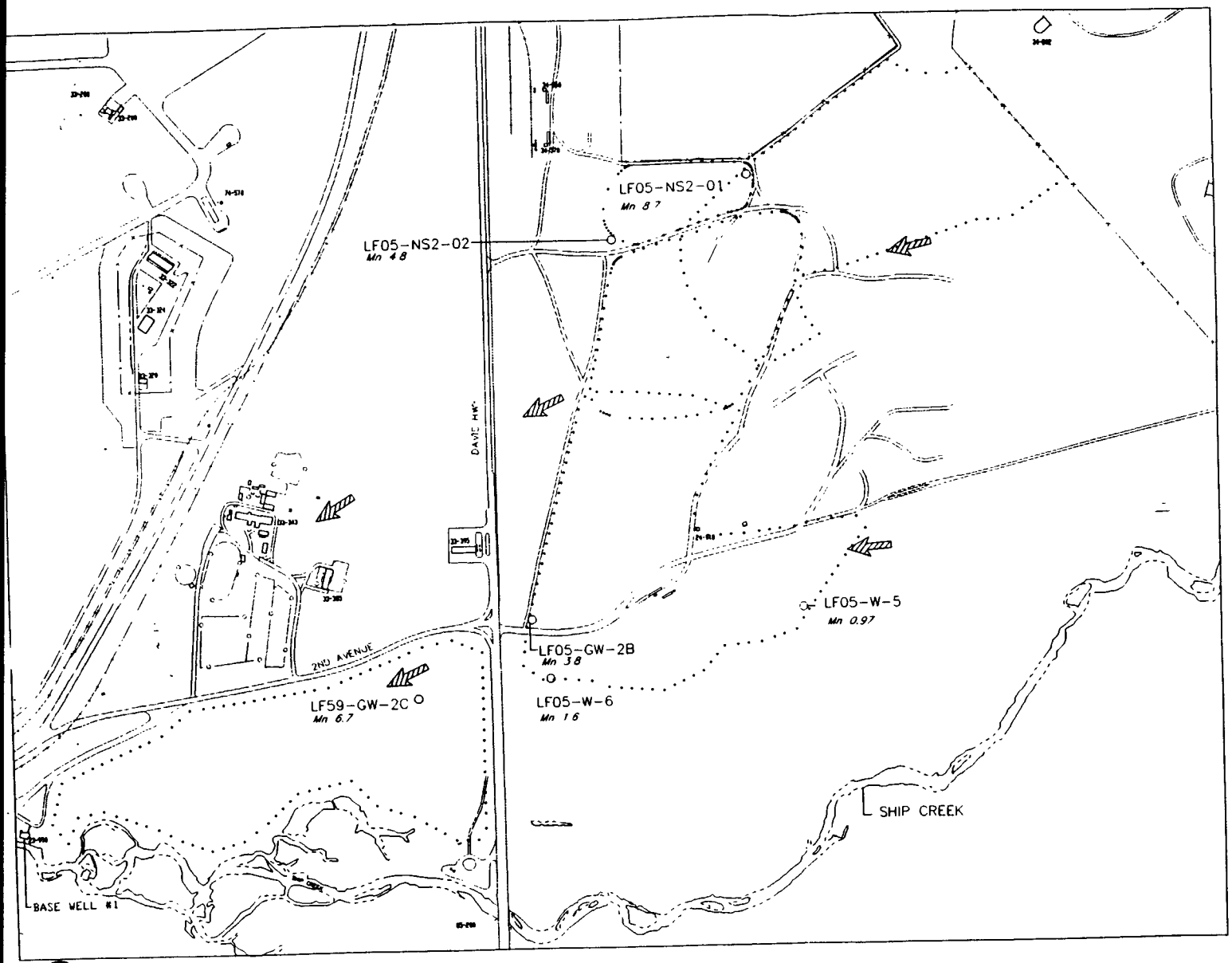
Arsenic was detected in four monitoring wells at levels only slightly above background conditions. The maximum concentration of arsenic detected was 140.0 *ug/l* in well LF05-W6. The high natural background concentration for arsenic is 76.0 *ug/l* (USGS). The maximum contaminant level (MCL) for arsenic is 50.0 *ug/l*.

The maximum concentration detected of 1,2-dibromoethane (EDB) was 0.38 *ug/l* in well LF05-W5. Although EDB was detected several times in the fall 1992 sampling event, only once was it detected above the MCL of 0.05 *ug/l*.

PCB (Aroclor 1260) was detected at a concentration of 14.0 *ug/l* only once, in well LF05-D13-02; 2 subsequent sampling events in the same well failed to confirm the presence of PCB. It is highly unlikely that this level of PCB could drop to undetectable levels, and the validity of the previous data is in question.

Lead exceeded the EPAs drinking water benchmark level of 15 *ug/l* when a concentration of 130 *ug/l* was detected in fall 1991 in well LF05-W5. Only two other wells, excluding upgradient wells, had concentrations which exceeded this benchmmark level.

Of the five, only the manganese was observed consistently and widespread throughout groundwater at the site. Figures 3, 4, and 5 depict manganese concentrations detected over the three rounds of sampling. Data obtained were compared with background conditions which were determined as follows: Groundwater samples were collected from upgradient wells GW-1A and GW-2A on four occasions and analyzed for total manganese: summer 1988, fall




N

LEGEND

- FENCE
- ROAD AND STREET
- BUILDING
- RAILROAD
- GROUNDWATER MONITORING WELL
- PRINCIPAL DIRECTION OF GROUNDWATER FLOW

NOTES

| ELEMENT | CONCENTRATION (mg/L) |
|---|---|
| Mn | 0.97 |

Mn = MANGANESE

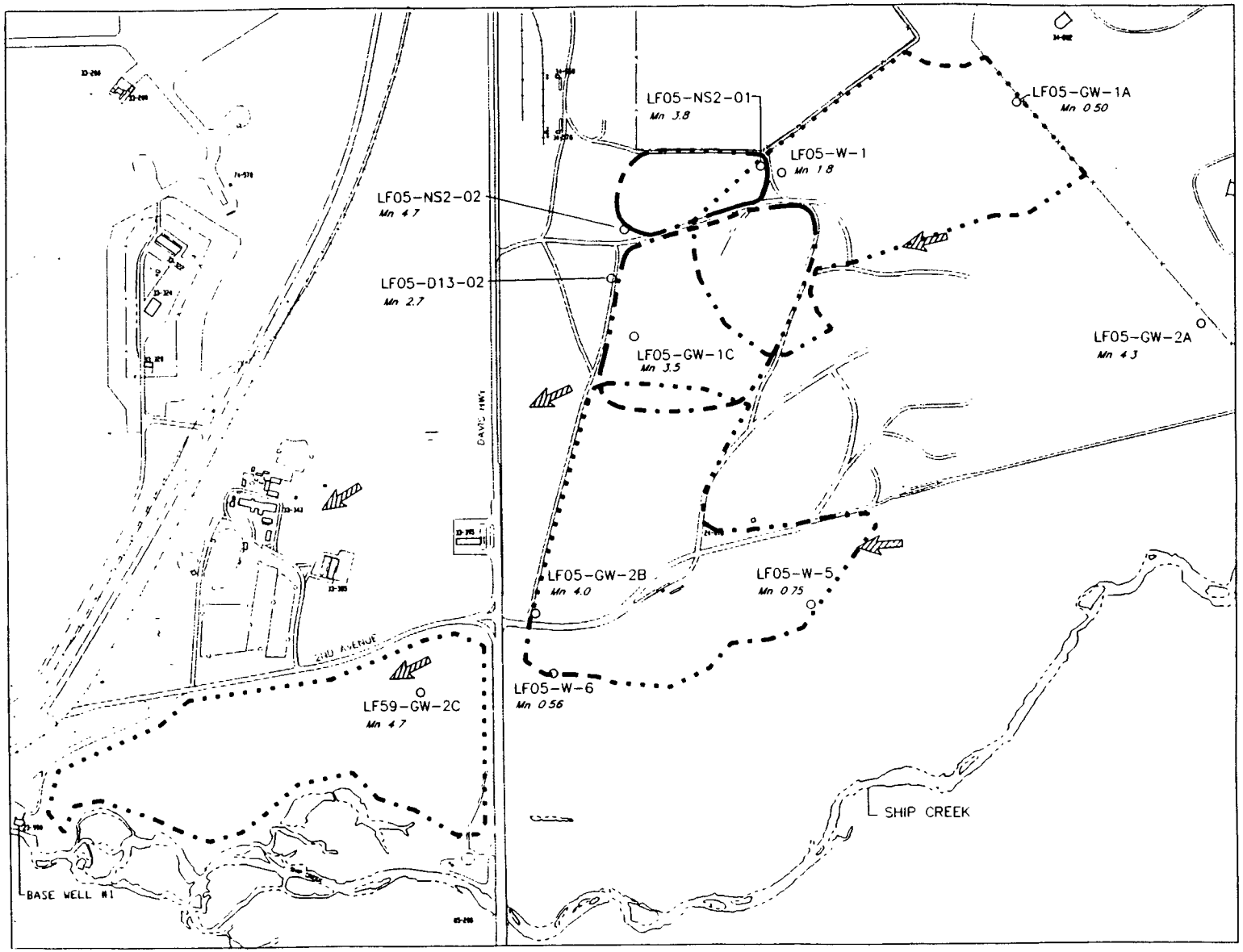
600 300 0 600 1200

SCALE IN FEET

| | |
|---|---|
| PROJ. MGR | |
| PROJ. ENG | |
| DRAWN BY | McCARTY |
| MADE FROM | G105_47F |
| ACAD FILE NO | G105_94A |
| DATE | 08/12/94 |

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA
FIGURE 3
OPERABLE UNIT 1
GROUNDWATER MONITORING WELLS
MANGANESE CONCENTRATIONS
(TOTAL ANALYSIS) FALL 1991

PROJ. NO. | FIGURE NO




N

LEGEND

- FENCE
- ROAD AND STREET
- BUILDING
- RAILROAD
- GROUNDWATER MONITORING WELL
- PRINCIPAL DIRECTION OF GROUNDWATER FLOW

NOTES

ELEMENT — CONCENTRATION (mg/L)
Mn — 0.50

Mn = MANGANESE

600 300 0 600 1200

SCALE IN FEET

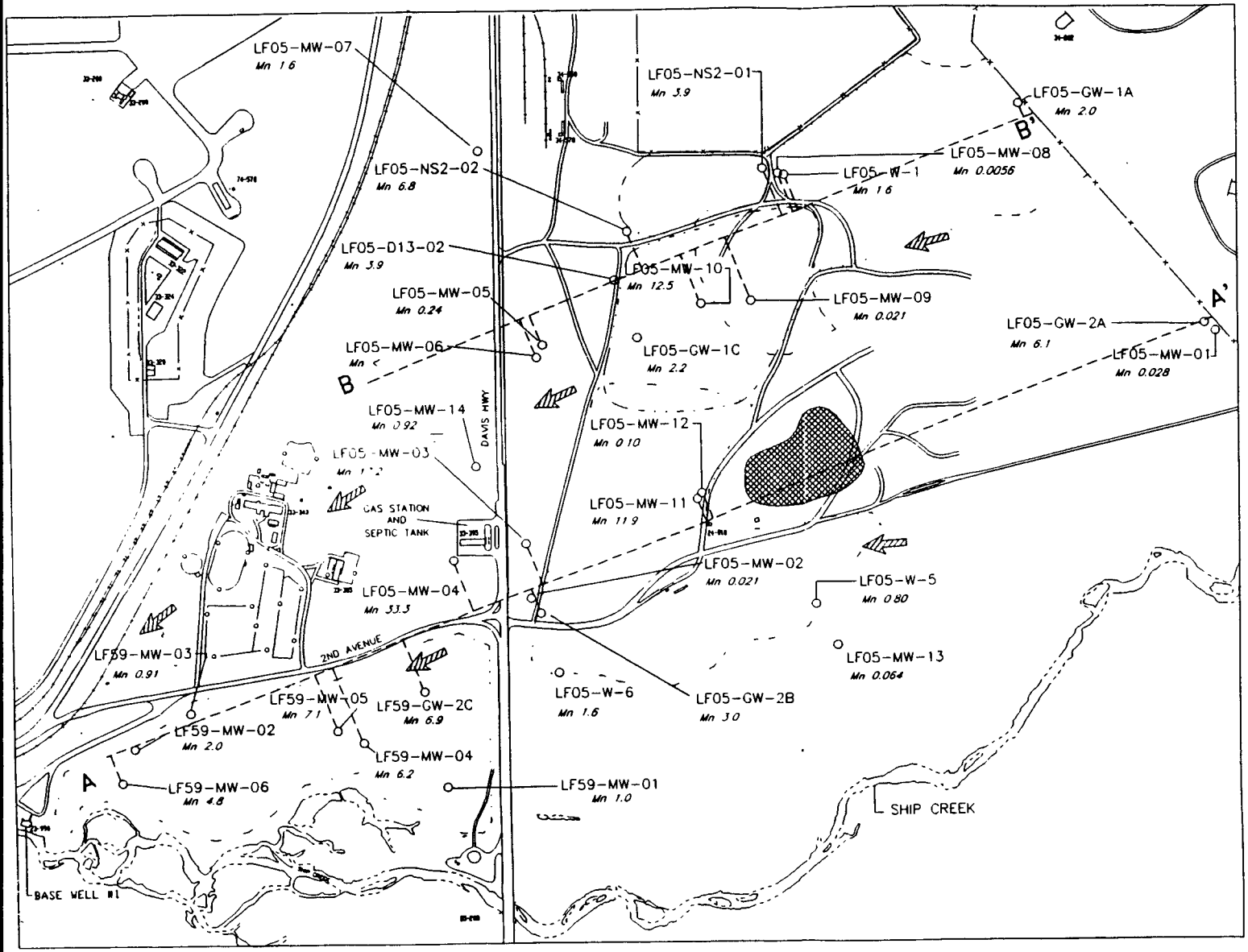
| | |
|---|---|
| PROJ MGR | |
| PROJ ENG | |
| DRAWN BY | McCARTY |
| MADE FROM | G105_15F |
| ACAD FILE NO | G105_94B |
| DATE | 08/12/94 |

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

FIGURE 4

OPERABLE UNIT 1
GROUNDWATER MONITORING WELLS
MANGANESE CONCENTRATIONS
(TOTAL ANALYSIS) SPRING 1992

PROJ. NO. | FIGURE NO




N

LEGEND

- FENCE
- ROAD AND STREET
- BUILDING
- RAILROAD
- GROUNDWATER MONITORING WELL
- PRINCIPAL DIRECTION OF GROUNDWATER FLOW
- SUSPECTED LANDFILL DISPOSAL CELL (BASED ON SURFACE GEOPHYSICS)

NOTES

| ELEMENT | CONCENTRATION (mg/L) |
|---|---|
| Mn | 0.0056 |

Mn = MANGANESE
< BELOW DETECTION LIMIT

600 300 0 600 1200

SCALE IN FEET

| | |
|---|---|
| PROJ. MGR | |
| PROJ. ENG. | |
| DRAWN BY | McCARTY |
| MADE FROM | G105_16F |
| ACAD FILE NO. | G105_94C |
| DATE | 08/12/94 |

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

FIGURE 5
OPERABLE UNIT 1
SOURCE AREA LF05 & LF59
GROUNDWATER MONITORING WELLS
MANGANESE CONCENTRATIONS
(TOTAL ANALYSIS) FALL 1992

PROJ NO. | FIGURE NO.

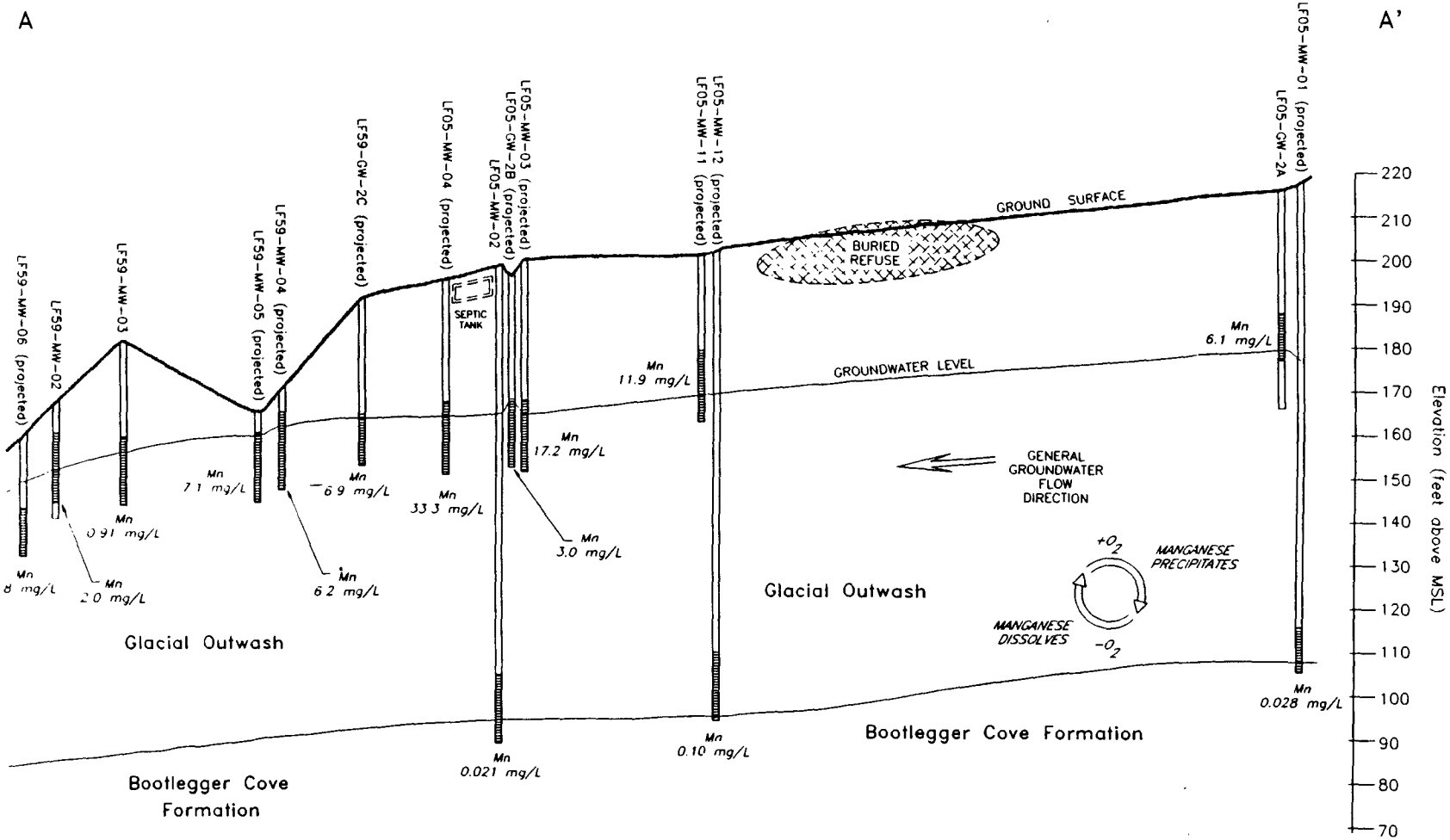
1991 spring 1992, and fall 1992. Statistical techniques were used to define an appropriate "background" total manganese level using these eight values. Specifically, the "background" total manganese level was chosen to be the 5 percent upper confidence limit (UCL) on the mean of the log transformed groundwater data from the upgradient wells. Any value greater than the 95 percent UCL is significantly greater than the mean of the upgradient data. The eight upgradient total manganese values ranged from 500 to 26,000 *ug/l*. The highest values, 13,000 *ug/l* (GW-1A) and 26,000 *ug/l* (GW-2A) were reported from samples collected in August 988. The 5 percent UCL was calculated to be 9,100 *ug/l*.

Manganese concentrations detected during the first two rounds of sampling were consistent with background conditions. Prior to the fall 1992 sampling event an additional seventeen monitoring wells were installed. The maximum concentration of manganese detected, 33,300.0 *ug/l* in well LF05-MW04, was not observed until the final round of monitoring during autumn 1992. Data obtained then indicated elevated levels of manganese coincidental with waste disposal cells within the landfill and the gas station area at OU1 (see figure 5). Manganese concentrations at downgradient locations were below statistically derived background conditions, as is evident in groundwater samples collected from the LF59 source area and from monitoring wells west of the L05/OT56 source areas. It appears that no groundwater contaminant plumes exist over time and that the manganese concentrations are not migrating. Figure 5 also shows the location of 2 cross sections. These cross sections, Figures 6 & 7, illustrate the depth at which manganese concentrations were detected, and conceptualize ideas regarding the cause of the manganese concentrations.

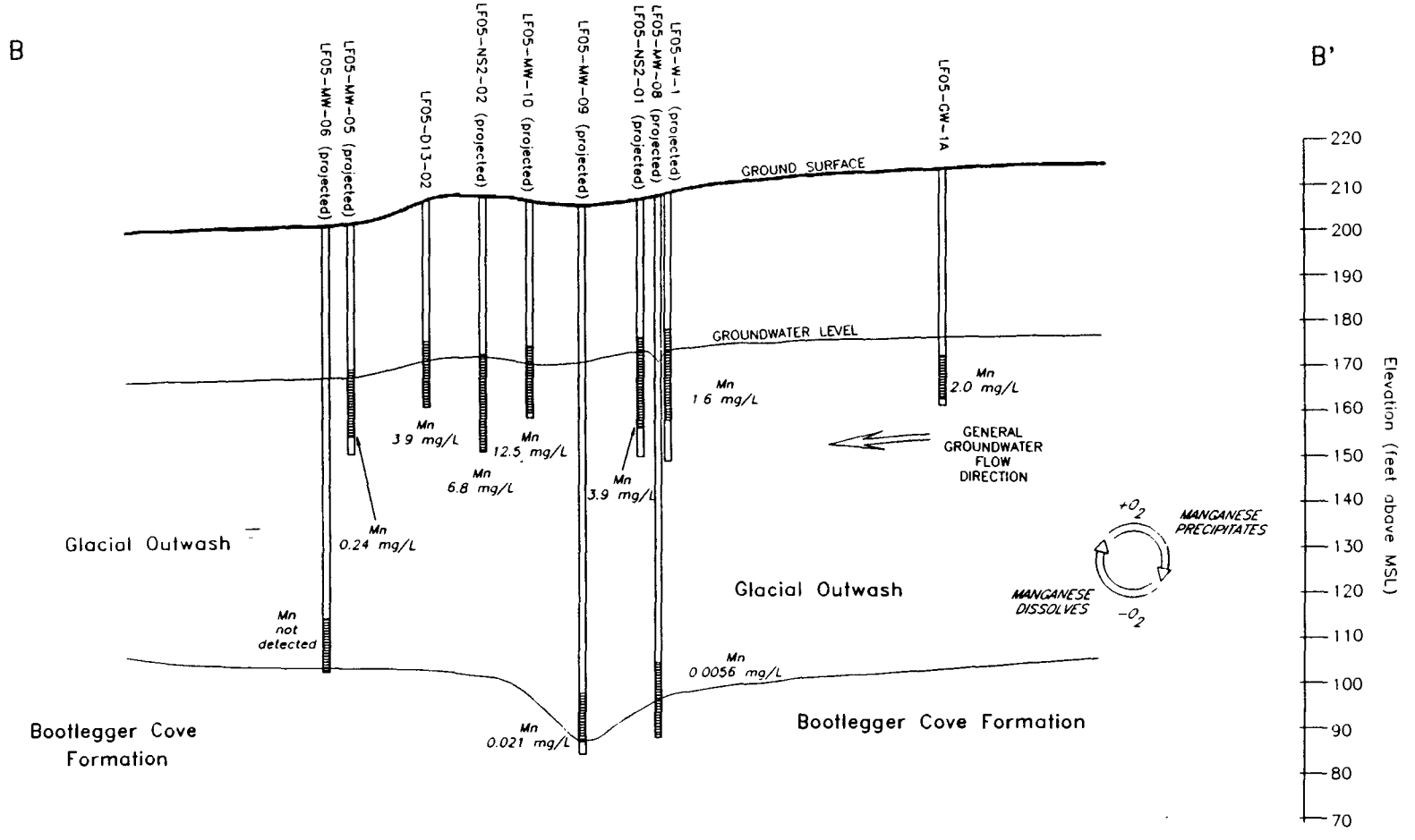
Soil concentrations of manganese are naturally high in the area as is common with glacial deposits. Data obtained from soil borings in the vicinity of the landfill cells did not indicate an unnatural source of manganese contamination. The reduction of solid manganese oxides to the soluble manganese species could be caused by bacterial decomposition of organic matter in the subsurface. As microorganisms degrade organic compounds in the subsurface, oxygen is consumed and aquifer conditions become reducing. These reducing conditions may cause the spontaneous dissolution of manganese or contribute to bacterially-mediated manganese liberation.

## 2.6 SUMMARY OF SITE RISKS

This section summarizes the human health risks and environmental impacts associated with exposure to site contaminants and provides potential remedial action criteria.




| | |
|---|---|
| PROJ MGR | ELMENDORF AIR FORCE BASE<br>ANCHORAGE, ALASKA |
| PROJ ENG | FIGURE 6 |
| DRAWN BY McCARTY | OPERABLE UNIT 1 |
| MADE FROM | MANGANESE CONCENTRATIONS (FALL 1992) |
| ACAD FILE NO OU1XSECA | CROSS SECTION A–A' |
| DATE 08/12/94 | PROJ NO / FIGURE NO |




0 800
SCALE IN FEET

| | |
|---|---|
| PROJ MGR | |
| PROJ ENG | |
| DRAWN BY McCARTY | |
| MADE FROM | |
| ACAD FILE NO OU1XSECB | |
| DATE 08/12/94 | |

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA
FIGURE 7
OPERABLE UNIT 1
MANGANESE CONCENTRATIONS (FALL 1992)
CROSS SECTION B-B'

PROJ NO | FIGURE NO.

### 2.6.1 Human Health Risks

A baseline risk assessment was conducted to estimate the risk posed to human health by OU1. The risk assessment consisted of an exposure assessment, toxicity assessment, and human health risk characterization. Chronic exposures to contaminated media are not currently occurring at OU1. The human health risk assessment therefore is based on two hypothetical exposure scenarios: a future residential land use scenario and a future commercial/industrial land use scenario.

The health risk evaluation used both the exposure concentrations and the toxicity data to determine a Hazard Index (HI) for potential noncarcinogenic effects and a cancer risk probability for potential carcinogenic contaminants. In general, an HI of less than or equal to 1 indicates that even the most sensitive individual is not likely to experience adverse health effects. The degree of concern typically correlates with the magnitude of the index if it is above 1. The cancer risk level is the additional chance that an exposed individual will develop cancer over the course of a lifetime. It is expressed as a probability such as 1E-06 (one in one million).

Contaminants of concern (COCs) were identified using the screening method suggested in the supplemental guidance for Superfund Risk Assessments in EPA Region X (EPA 1991). This method, called the "risk-based screening approach", compares the highest concentration of each chemical detected at a site to a risk-based screening concentration. According to the National Contingency Plan a risk range of 1E-04 to 1E-06 is acceptable. At OU1 the COCs detected did not occur at concentrations above EPA acceptable risk ranges in soil nor in surface waters. The only COCs identified were in the shallow groundwater at OU1. COCs detected were arsenic, EDB, PCB, lead, and manganese.

Risks were calculated using exposure point concentrations equal to the highest concentrations detected (see Table 1). Exposure assumptions include potential future receptors drinking and showering from an unfiltered shallow well in the immediate vicinity of the highest concentration of COCs over a time of 30 years. Sources of toxicity data used in the risk assessment were (in order of preference): Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tabs (HEAST), and the USEPA Superfund Technical Support Center. Risks associated with the five COC are presented in Table 2.

A comparison of site-related risk and risk associated with background conditions indicates that risks associated with arsenic are not site related. Risk for arsenic was calculated

# TABLE 2
# HUMAN HEALTH RISKS GREATER THAN 1E-04

| CONTAMINANT | SITE RELATED | | BACKGROUND | |
|---|---|---|---|---|
| | RISK/HI[1] | CONC (*ug/l*) | RISK/HI[2] | CONC (*ug/l*) |
| Arsenic | 2.9E-04 | 140.0 | 1.8E-04 | 76.0 |
| 1,2-Dibromoethane | 3.8E-04 | 0.38 | NA | |
| Manganese | 198.0 HI | 33,300.0 | 36.3 HI | 9,100.0 |
| PCB (Aroclor 1260) | 3.4E-03 | 14.0 | NA | |
| Lead | 63%[3] | 130.0 | 6%[4] | 45.0 |

1 Risk associated with from drinking groundwater from an unfiltered shallow well in the immediate vicinity of the highest concentration of COC over a time of 30 years.

2 Risk associated with drinking groundwater with background concentration of COC over a time of 30 years.

3 Percentage of children ages 0 to 7 who would have a blood-lead level of greater than 10 *ug/dl* after ingesting water containing 130 *ug/l* of lead. Calculated using the EPAs Biokinetic Uptake Model.

4 Percentage calculated the same as for note 3, above. The value is based on a lead concentration of 45 *ug/l* that was detected in an upgradient monitoring well, LF05-GW-2A.

using a maximum concentration of 140.0 *ug/l* , detected in well LF05-W6. Background risk for arsenic was calculated using the high natural background concentration of 76.0 *ug/l* (USGS).

The risks calculated for EDB were based on a maximum concentration of 0.38 *ug/l* detected in well LF05-W5. This was the only detection of EDB above the MCL of 0.05 *ug/l* and above the EPA acceptable risk range of .00075 *ug/l* to .075 *ug/l*.

For PCB (Aroclor 1260) risk was determined using the only concentration detected of 14.0 *ug/l*, in well LF05-D13-02. As discussed in Section 2.5 this data is of questionable validity.

Risks were calculated for lead using EPAs Biokinetic Uptake Model. The model was developed to estimate the level of lead in blood, since this is the most sensitive indicator of lead exposure. EPA has determined that a blood-lead range of 10 *ug* to 15 *ug/dl* (micro-grams of lead per deci-liter of blood) represents a level of concern. It is generally accepted that if no more than 5 percent of exposed children are estimated to have blood lead levels of 10 *ug/dl*, a significant health hazard due to lead is not deemed to exist. The model incorporates media-specific uptake factors for exposure to lead, concentrations of lead, and exposure factors. Site-specific information on lead levels found at OU1 were entered into the model and the resulting values were compared with EPA's level of concern of 10 *ug/dl* using probability density functions. The percentage of children estimated to have blood lead levels above 10 *ug/dl* of blood was greater than 5 percent at only four out of thirty-one locations monitored within OU1: LF05-W-5 with 63% based on a maximum concentration of 130 *ug/l*; LF05-W-6 with 6% based on a concentration of 46 *ug/l*; LF05-NS2-01 with 8% based on a concentration of 49 *ug/l*; and LF05-GW-2A with 6% based on a concentration of 45 *ug/l*. Furthermore, LF-05-GW2A is an upgradient of monitoring locations. The sporadic detections of lead at OU1 do not appear to pose any threat under the current land use scenario.

Of the contaminants detected above acceptable risk ranges, only manganese was observed consistently and widespread throughout shallow groundwater at OU1. Risk associated with manganese were calculated using a concentration of 33,300.0 *ug/l*, detected in well LF05-MW04. Background risks for manganese were calculated using a background level for manganese of 9,100 *ug/l*, based on a range of background concentrations ranging from 500 to 26,000 *ug/l*. The background concentration was statistically derived as described in Section 2.5.

### 2.6.2 Uncertainties Associated With the Risk Assessment

Risk assessments involve calculations based on a number of factors, some of which are uncertain. The effects of the assumptions and the uncertainty factors may not be known. Usually, the effect is difficult to quantify numerically, so the effect is discussed qualitatively. Some of the major assumptions and uncertainty factors associated with the risk assessment are the following:

- The assessment used EPA Region 10 default exposure parameters for most calculations. Some of these parameters are not realistic for a subarctic climate (May overestimate risk).
- Existing concentrations are assumed to be the concentrations or exposure source terms in the future. No reduction through natural degradation and attenuation over time is taken into account (May overestimate risk).
- No increase through additional contamination is assumed (May underestimate risk).
- Potential degradation products of existing organic contaminants are not considered (May overestimate or underestimate risk).

### 2.6.3 Environmental Evaluation

An ecological assessment was conducted at OU1 which determined risks that exist for both the terrestrial ecosystem and the aquatic ecosystem. The characterization of the aquatic risks, specifically those at Ship Creek, was uncertain due to the limited availability of data. Risk to the aquatic ecosystem are being investigated further under OU6 studies ongoing at the base.

The terrestrial risk assessment identified a potential environmental risk due to the presence of several heavy metals within the soils of OU1. These metals include cadmium, mercury, lead, and barium. Cadmium was found at only one surface soil sample location. Mercury was detected in concentrations up to 0.26 mg/kg at three surface soil sample locations east of the Davis Highway and two locations west of the highway at OU1. Lead was detected in concentrations exceeding 25 mg/kg at only two locations east of the Davis Highway and none to the west. Barium was found in concentrations exceeding 150 mg/kg at three locations, one east of the Davis Highway and two to the west.

These high levels are an indication of isolated "hot spots" which do not pose a significant risk and do not warrant remedial action.

Localized small mammal and passerine bird populations at OU1 may be at risk from ingestion of heavy metals. However, exposure to heavy metals is expected to be limited due to the limited aerial extent of contamination and the relatively large habitat. The results of the ecological risk assessment indicate potential theoretical risk to migratory peregrine falcons exposed to heavy metals at OU1. However, there is no habitat at OU1 which would attract peregrines to the area, making it extremely unlikely they would come in contact with contaminants at the site. Also, there have been no verified sightings of peregrines on Elmendorf AFB in the past seven years.

## 2.7 DESCRIPTION OF ALTERNATIVES

### 2.7.1 Remedial Action Objectives

The Feasibility Study recommended that OU1 be considered for remedial action because of the potential risk from unrestricted domestic use of groundwater containing manganese. The Baseline Risk Assessment concluded that the greatest risks at OU1 are associated with manganese in the shallow groundwater.

Assumptions made during the RI/FS and decision making process include:

- The RI determined that concentrations of manganese present in the site soils are commensurate with background conditions and there is currently no identifiable source of further groundwater contamination. Therefore, no remediation of the site soils was deemed necessary, and no remedial action objectives were developed for the site soils.

- Data obtained during 1991 and 1992 indicate there are no contaminant plumes in the groundwater at OU1 and that the manganese is not migrating. This situation makes most groundwater cleanup alternatives ineffective, such as pump and treat or containment of the contaminated groundwater.

- A reducing environment is thought to be responsible for elevated manganese concentrations in groundwater. Containment of the landfill by installing a cap would locally reduce the infiltration of oxygen and exacerbate the reducing environment, and is therefore not considered effective.

- Existing land use controls prevent current exposure to shallow groundwater at the site and will be insured in the future by Air Force policy and federal land transfer regulations, in order to continue to prevent exposure to manganese above health-based levels at the site.

The remedial action goal for the OU1 source area is to prevent ingestion/direct contact with groundwater containing contaminants in concentrations in excess of background or MCLs, whichever is greater.

The goal is to reach the concentrations described below:

| Contaminant | Background (*ug/l*) | MCL (*ug/l*) |
|---|---|---|
| 1,2-Dibromoethane | | 0.05 |
| Manganese | 9,100.0 | |
| Trichloroethylene | | 5.0 |
| Vinyl Chloride | | 2.0 |

Figure 8 shows contaminant concentrations detected during the RI/FS that exceed these remedial action goals.

### 2.7.2 Remedial Alternatives

Three alternatives were developed and thoroughly analyzed in the FS.

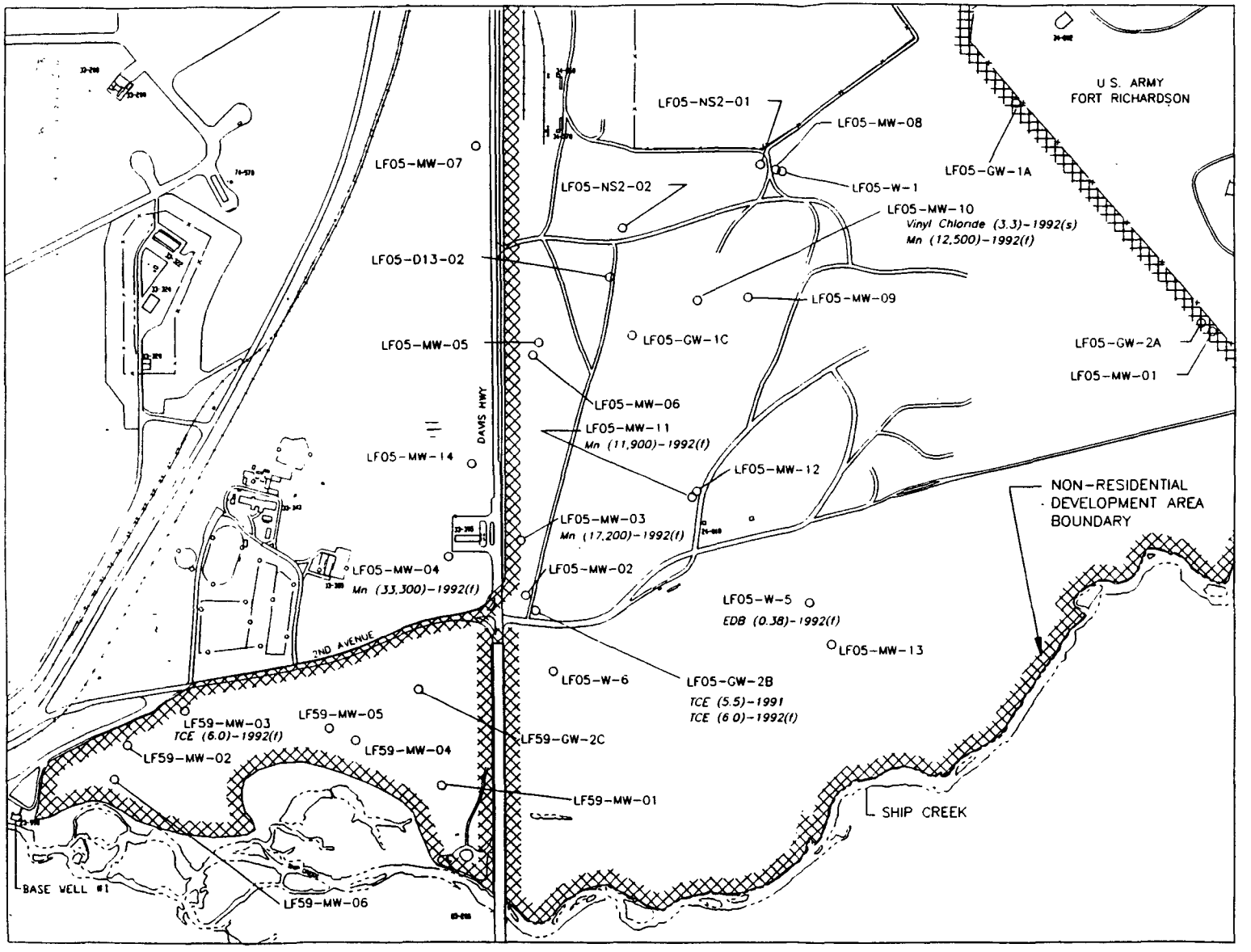
**Alternative 1: No Action**

Capital Cost: $0

Five-Year O&M Cost: $0

Evaluation of the No Action alternative is required under CERCLA, serving as a common reference point against which other alternatives can be evaluated.

Under this alternative, no additional action would be taken to mitigate or monitor the contaminants found at the site.




N

LEGEND

- FENCE
- ROAD AND STREET
- BUILDING
- RAILROAD
- GROUNDWATER MONITORING WELL

| CONTAMINANT | CONCENTRATION (µg/L) |
|---|---|
| *Vinyl Chloride* | *(3.3)* |

*1992(f) = FALL 1992*
*1992(s) = SPRING 1992*

REMEDIATION GOALS

| CONTAMINANT | MCL (µg/L) |
|---|---|
| *1,2-dibromoethane (EDB)* | *0.05* |
| *Vinyl Chloride* | *2* |
| *Trichloroethylene (TCE)* | *5* |

| CONTAMINANT | BACKGROUND (µg/L) |
|---|---|
| *Manganese (Mn)* | *9,100* |

600 300 0 600 1200

SCALE IN FEET

| | |
|---|---|
| PROJ. MGR. | |
| PROJ. ENG. | |
| DRAWN BY | McCARTY |
| MADE FROM | OU1_A |
| ACAD FILE NO. | OU1_AUG |
| DATE | 08/12/94 |

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

FIGURE 8
OPERABLE UNIT 1
CONTAMINANT CONCENTRATIONS
THAT EXCEED
REMEDIAL ACTION OBJECTIVES

PROJ. NO. | FIGURE NO.

**Alternative 2: Limited Action with Long-Term Monitoring of Groundwater**

Capital Cost: $0

Five-Year O&M Cost: $240,000

This alternative includes continued groundwater monitoring to detect and evaluate any changes in contaminant concentrations and maintaining institutional controls (including base directives and restrictive covenants) to prevent the use of the contaminated groundwater underlying OU1.

Institutional controls would include:

- Development of a site map showing the areas currently and potentially impacted by groundwater contaminants;
- Zoning the affected area for undeveloped outdoor/recreational use only;
- Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying Elmendorf AFB; and
- Securing of existing water supply and groundwater monitoring wells.

These controls will remain in effect as long as the Air Force maintains active control of the area or until the groundwater contamination dissipates to levels which are statistically equivalent to background concentrations and that will no longer pose any unacceptable human health or environmental risks.

Wells will be monitored to evaluate the fate and transport of contaminants at OU1 and to verify assumptions made during the RI. The details of monitoring and evaluation will be developed in the OU1 Long Term Monitoring Plan documents.

**Alternative 3: In Situ Treatment of Groundwater**

Capital Cost: $201,000

Five-Year O&M Cost: $495,000

Alternative 3 includes an in situ treatment process for groundwater contaminated with elevated levels of manganese. It is currently thought that low levels of organic compounds released by the landfill interact with soil particles and allow the manganese to be dissolved into solution in the groundwater.

This process could be impeded by the injection of oxygen into the shallow groundwater aquifer, causing the manganese to oxidize and separate out. Once this occurs, the manganese would be adsorbed onto soil particles in the aquifer, allowing the groundwater manganese concentrations to return to background levels. This process already appears to be occurring down gradient of the elevated manganese concentrations.

The same groundwater monitoring program proposed under alternative 2 would be used to monitor the effectiveness of this treatment process. This alternative would need to be maintained indefinitely, or until the chemical process releasing the manganese ceased. Alternative 3 is an innovative technology, which may or may not achieve the desired objectives or could induce other alterations in the groundwater which may mobilize other soil constituents. This alternative is based on the assumption that organics in LF07 are causing manganese levels in groundwater to increase.

## 2.8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section summarizes the relative performance of each of the three alternatives with respect to the nine CERCLA evaluation criteria.

### 2.8.1 Threshold Criteria

**Overall protection of human health and the environment.** Alternative 1, No Action, provides no protection for future users of the site or for the environment. Alternatives 2 and 3, Institutional Controls and In Situ Treatment, both provide overall protection of human health in accordance with the NCP.

**Achievement of Applicable Relevant and Appropriate Requirements (ARARs).** The Safe Drinking Water Act, Title 40 Code of Federal Regulations, is relevant and appropriate. Under alternative 2, groundwater will be monitored and institutional controls maintained until sampling determines that the MCLs have been reached and risks are acceptable.

### 2.8.2 Primary Balancing Criteria

**Long-term effectiveness.** The groundwater monitoring program proposed under Alternative 2 would provide a long-term effective measure by which human health and the environment would be protected by alerting the Agencies if the manganese began to increase or migrate. It is expected that long-term monitoring will show that, over time, manganese concentrations will decrease through natural processes.

Alternative 3 meets the remedial action objectives for groundwater by reducing the elevated manganese to background conditions and would be effective in removing/reducing existing concentrations on a permanent basis. However, to be most effective, Alternative 3 would need to operate until the landfill cells no longer release organic compounds to the groundwater.

**Reduction in toxicity, mobility, or volume of contaminants through treatment.** Alternative 2 does not actively reduce toxicity, mobility, or volume of the elevated concentrations of manganese at OU1. Alternative 3 would reduce the toxicity, mobility and volume of manganese in groundwater by actively treating it.

**Short-term effectiveness.** None of the groundwater remedial alternatives would 1) cause any increased environmental impacts or 2) pose additional short-term risks to workers or the community. Under Alternatives 2 and 3 the effectiveness and need for continuing the monitoring program would be re-evaluated by the Agencies at the end of five years of monitoring. Alternatives 3 would provide greater short-term effectiveness because active groundwater treatment would decrease manganese from the start of remedial operations. Monitoring would help ensure that the manganese does not impact any possible down-gradient receptors.

**Implementability.** Alternative 2 would be readily implementable because of existing controls. Groundwater monitoring programs and base institutional controls to restrict use of water in the shallow aquifer are already in place. In addition, in the event of base closure, federal land transfer regulations would ensure that these controls remained in place. Alternative 3 is not as readily implementable because the treatment technology has not been applied and would require a design and construction period.

**Cost effectiveness.** Long-term monitoring is the only cost required for Alternative 2 and will cost $240,000 for five years. Alternative 3 is estimated to cost $696,000 for initial installation and five years of monitoring. There would be additional costs for long-term monitoring, which were not calculated in the feasibility study. Alternative 2 is considered cost effective when compared with alternative 3.

### 2.8.3 Modifying Criteria

**State acceptance.** The State of Alaska concurs with the Air Force and EPA in the selection of Alternative 2.

**Public Acceptance.** Based on the comments received from the public and the support given by the TRC, the public supports the selection of Alternative 2.

## 2.9 SELECTED REMEDY

The selected remedy to manage risks posed by elevated manganese concentrations in the shallow groundwater at OU1 is Alternative 2: Limited Action with Long-Term Monitoring of Groundwater. Alternative 2 is selected based on the following five site specific considerations:

- The groundwater monitoring program will provide early warning of any increase in concentrations or movement of manganese.
- Existing land use controls will ensure no current exposure to shallow groundwater. Institutional controls and required property transfer provisions of CERCLA will ensure that there will be no exposure to shallow groundwater in the future.
- Elevated levels of manganese appear to be isolated within a limited area and are not anticipated to migrate.
- The source of the manganese is uncertain.
- There is no current human exposure to manganese in the shallow groundwater.

The major components of the selected remedy include:

- institutional controls;
- monitoring groundwater for five years, or until the groundwater poses an acceptable health risk;
- five-year review to assess the protectiveness of the remedial action; and
- periodic evaluation of monitoring results to determine if there is need for further remedial action.

## 2.10 STATUTORY DETERMINATIONS

The selected remedy satisfies the requirements under Section 121 of CERCLA to:

- protect human health and the environment,
- comply with the ARARs,
- be cost-effective, and

- utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

### 2.10.1 Protection of Human Health and the Environment

The selected remedy, Alternative 2, will reduce the risks posed to future users of Operable Unit 1 by establishing institutional controls that restrict use of the land and the shallow aquifer. Current trends indicate reduction of contamination to background levels occur naturally before groundwater migrates off-site. The long-term monitoring will provide early warning of any increase or movement of the manganese. Based on the above information, the selected remedy is protective of human health and the environment.

### 2.10.2 Compliance with ARARs

The selected remedy calls for groundwater monitoring and maintenance of institutional controls until sampling determines that the remediation goals have been reached and risks are acceptable. Therefore, the selected remedy complies with all ARARs, listed below:

- MCLs established under the Safe Drinking Water Act are relevant and appropriate requirements for groundwater that is a potential drinking water source:

| Contaminant | MCL (*ug/l*) |
|---|---|
| 1,2-Dibromoethane | 0.05 |
| Trichloroethylene | 5.0 |
| Vinyl Chloride | 2.0 |

- Alaska Oil Pollution Regulation (18 AAC 75). Under the Alaska Oil Pollution Regulations, responsible parties are required to cleanup Oil of Hazardous Substance releases. Due to the sporadic, infrequent nature of groundwater contaminant sample results and the lack of source areas, it is the general opinion that the groundwater contaminant trend is decreasing in concentration through time. Under 18 AAC 75.327, the ADEC has the authority to determine alternative cleanup standards for groundwater. In accordance with this requirement, the purpose of the monitoring is to verify that groundwater contaminantion is decreasing and will meet acceptable human health risk levels and Safe Drinking Water standards within an acceptable time limit, which is expected to be five years from initiation of the monitoring program.

### 2.10.3 Cost-Effectiveness

The selected remedy is cost-effective because it has been determined to provide overall effectiveness proportionate to its costs and duration to achieve the remediation goals. Alternative 3 with a cost of $696 thousand plus additional costs for long term monitoring that would be required by the State, is significantly more costly than the selected remedy. Given the uncertainty about the effectiveness of in-situ treatment, introducing oxygen to the aquifer, the benefits of active remediation do not justify the cost.

### 2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The U.S. Air Force, the State of Alaska, and EPA have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in cost-effective manner at the OU1 site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the U.S. Air Force, the State of Alaska, and EPA have determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost (as discussed in the preceding section), and the statutory preference for treatment as a principal element and considering State and community acceptance.

All alternatives would use readily available technologies and would be feasible to construct. Alternatives 1 and 2 would be readily implementable; they require no additional remedial action. The technologies involved in Alternative 3 are relatively limited in scope.

The most decisive factors in the selection decision were long-term effectiveness and implementability. Alternatives 2 provides the best option for cost-effective and practical remediation of OU1, because it is expected manganese concentrations will return to background conditions in time. Alternative 3 would in principle reduce the concentrations of manganese in the aquifer more quickly; however, given the fragile nature of the geochemical environment, it presents considerable risk of mobilizing additional contaminants that could prove more hazardous than the existing conditions.

## 2.11 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy was the preferred alternative presented in the Proposed Plan. No changes have been made.

## SECTION 3

## RESPONSIVENESS SUMMARY

The Proposed Plan for OU1 was issued to the public on 4 April 1994. This began a public comment period that ended on 3 May 1994. In order to encourage public comment, the USAF inserted pre-addressed, written comment forms in distributed copies of the Proposed Plan. In addition, comment forms were also distributed at the 21 April 1994 public meeting held at the Federal Building to receive comments on the Proposed Plan.

The public meeting was attended by 19 people, including 4 community members. Oral comments were received from 3 people: one representative from Physicians for Social Responsibility, and two citizens representing themselves.

Following the public meeting and prior to the conclusion of the public comment period comments were submitted by three individuals.

All comments received are documented in the administrative record file for the site. A transcript of the public meeting is available for public review at the site information repositories. The repositories are located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska at Anchorage's Consortium Library.

Public comments, relevant to OU1 and/or the environmental restoration program at Elmendorf, are presented below and have been paraphrased for greater clarity.

### COMMENTS AND RESPONSES

1. How were the various sites numbered; does the OU number correspond with its priority?

**Response:** Source areas were numbered in the order they were discovered. OU numbers do not reflect priority or relative degree of severity, but are random. OU1 was the first to undergo investigation because of its proximity to Ship Creek and the base boundary and the uncertainty concerning the type of contaminants disposed of.

2. Another OU drains into Ship Creek; why not investigate them together?

**Response:** The sites were grouped separately to make them more manageable. The cumulative effects of the sites will be investigated along with the last OU. In addition, a Biological Technical Assistance Group has been formed to look at impacts to Ship Creek from all sites in the area, not just Elmendorf AFB.

3. How does the Air Force allocate funds for the different sites? How much money was spent in the OU1 investigation?

**Response:** A Defense Priority Model is used to score each site based on its potential impact to human health and the environment. Program funding requirements are submitted through Air Force Channels to the Department of Defense and ultimately congress along with the relative priority of the site. Approximately 2 million dollars were spent at OU1.

4. How is a decision made to select an alternative that will not completely clean up a site?

**Response:** Alternatives are evaluated based on the nine criteria discussed in the Proposed Plan and Record of Decision. The criteria include factors beyond how clean an alternative can get the site. In the case of OU1, the more "active" alternative involving in-situ treatment could mobilize other metals making the situation worse. The preferred alternative is considered to be protective of human health and the environment.

5. How did the program begin; was the base listed on the National Priorities List due to OU1 sampling?

**Response:** The Installation Restoration Program began looking at environmental impacts from past waste disposal activities in the early 1980's. This was an Air Force directive implemented across the country in response to growing awareness of and concern for environmental quality. The base was not listed on the National Priorities List due to sampling conducted at OU1.

6. How old are the landfills and what prompted the Air Force to start the investigation at OU1?

**Response:** The OU1 landfill sites were operated anywhere from the early 1950's until the 1983. Due to their age and the lack of sound waste management practices at that time, there was a high potential for hazardous wastes having been disposed of in the landfills. Review of aerial photographs revealed disposal areas including trenches that may have received liquid waste. Interviews with people working on and living around the base during the time the landfills were active further supported the need for investigation. In addition, a trench well within OU1 that was shut down because it exhibited possible contamination led to beginning the remedial investigation.

7. How long has the base been measuring manganese in Ship Creek?

**Response:** The base has been tracking water quality in Ship Creek since 1984. Measurements are made three times a year in spring, summer and fall.

8. How is the deeper aquifer protected when installing a well through the clay layer that separates it from the shallow, contaminated aquifer?

**Response:** When drilling the well a casing is installed to the top of the clay layer prior to penetrating the clay. A plug is put to further ensure no cross contamination. Drilling then continues through the clay and into the deeper aquifer. Additional information on construction of monitoring wells is contained in the Management Plans and Remedial Investigation/Feasibility Study Report for OU1.

9. If the deeper aquifer used for drinking water isn't in danger, is the potential danger to Ship Creek?

**Response:** Yes, there is a potential danger to Ship Creek. Impacts to Ship Creek are being investigated further under OU 6. Furthermore, there is a risk to potential drinkers of the shallow aquifer. The shallow aquifer is not currently used for drinking water and the base prohibits its use for any reason. The institutional controls being put in place will ensure the shallow aquifer is not used.

10. What health concerns besides Parkinson's Disease are associated with manganese?

**Response:** For industrial workers pneumonia or other lung toxicity problems may be associated with inhalation of manganese dust. There may be other central nervous system effecting syndromes, similar to Parkinson's, associated with elevated levels of manganese.

11. Why wasn't a pilot study done to evaluate the in-situ treatment alternative?

**Response:** The elevated manganese wasn't identified until the final round of sampling. Only one well showed manganese at levels of concern. A pilot study was not warranted at the site.

12. Has the Air Force found the source of the manganese?

**Response:** The manganese is elevated as a result of a chemical process that is initiated by the presence of organic compounds. The source of the manganese is the natural soil. The source of the organics could be one or more of the landfill cells at OU1.

13. Alternative 3 has not been adequately characterized based on the question of State acceptance. It is important to evaluate an actual cleanup alternative rather than long term monitoring.

**Response:** Risk was calculated based on a very conservative scenario (residential land use). Alternative 2, which restricts land use, is fully protective of human health and the environment. Treatability studies required to further evaluate alternative 3 may mobilize other metals in the aquifer causing additional risks rather than reducing the risk associated with manganese.

14. The Air Force (Elmendorf) should be more proactive (with its actions at OU1).

**Response:** The Air Force has a proactive program. Part of that is weighing out all the factors when evaluating a cleanup alternative. Based on an evaluation of the nine criteria discussed in the Proposed Plan, the Agencies collectively prefer limited action with long term monitoring for addressing elevated levels of manganese in the groundwater underlying OU1.

15. It seems that OU1 is not a big problem, and that the manganese is contained. It seems that there would have been a worse site to deal with first.

**Response:** In the beginning of the investigation, the Air Force was unsure what degree of contamination would be found. It is true that the problems at OU1 are relatively mild.

16. The Air Force is talking in terms of risk management when it should be talking in terms of risk reduction.

**Response:** Since the risk at OU1 is potential rather than currently existing, risk management and risk reduction are essentially the same.